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FIELD INSTRUCTIONS FOR FARMERS' COOPERATIVE
DEMONSTRATION WORK.**COMMERCIAL FERTILIZERS—THEIR USES AND COST.**

Since the prime object in the use of all commercial fertilizers is to increase production, they must be used either to supply plant food directly or to so act upon the soil that a larger quantity of its nutritive elements will be at the disposal of the plant. In actual practice most commercial fertilizers combine both effects. All the substances required by plants are abundant in most soils except three—nitrogen, phosphoric acid, and potash.

Nitrogen, so necessary to the growth of plants, is found abundantly in the atmosphere, but it can not be used by plants in that form. It must be combined with other substances. Its familiar combination is known as ammonia. Nitrogen combines with a great many substances, but it is always trying to escape from them, and it is because it is so difficult to hold it in these combinations that it is expensive. The chief function of nitrogen in plants is to promote growth, but it is also of very great importance in the perfection of fruit.

Since nitrogen enters so largely into the composition of plants, it follows that everything of vegetable origin is a valuable source of this substance. This should be thoroughly appreciated. When vegetable matter is burned upon the farm, the nitrogen is released from its combination and escapes into the atmosphere and is lost. On the other hand, if this vegetable matter is returned to the soil, when it decays the combined nitrogen is placed where it is available for plant food. The forms most important to the farmer of the South in which nitrogen is available are cotton-seed meal, bone meal, the products of the slaughter pen in what is known as tankage, nitrate of soda, and sulphate of ammonia.

Next in importance as a plant food is phosphoric acid. This substance, or rather phosphorus, of which it is a compound, is familiar to all in phosphorescent wood and the common match. It is largely required by the plant for growth, but is absolutely essential in the perfection of seed and is a great factor in hastening the maturity of crops. It is the presence of phosphoric acid and potash in wood ashes that makes them valuable as a fertilizer.

Phosphoric acid is also found combined with lime, in bones and in rock. In these forms it must be treated with acid in order to be taken up rapidly by plants, and thus treated it is changed into two forms—reverted phosphoric acid and soluble phosphoric acid. The former is soluble slowly in water or weak acids, such as are found in the soil, while the latter is readily dissolved by water. These two are called available phosphoric acid because the plants can use them. The most accessible form of phosphoric acid to the farmer is known as acid phosphate. This is the product of the treatment of the insoluble rock phosphate with acid, and thus treated it contains the phosphoric acid in all three of the above forms.

Potash is more directly effective in the perfection of fruit, but it is rarely very deficient in soils, and especially in soils of the Gulf States. It is found in abundance in ashes and is there known as lye. Commercially it is most cheaply obtained in the form of kainit.

WHAT FERTILIZER TO BUY.

Since the elements of plant food above mentioned are required in different quantities by different plants and since the soils vary in their supply, it is well for the farmer to know what his soil and plants need before investing his money in fertilizers. A great many have the impression that the chemist can analyze a soil and answer these questions. This is not the case, however, and even if he could a farmer can not afford to send for a chemist every time he wants to plant a field. The practical way for the farmer to determine these facts is to observe the growth of the plants on that land. If the plants grow very rapidly and make an abundance of leaf and stalk it is evidence of a good supply of nitrogen. If there is not a proportionate amount of fruit, it is a sure indication that the soil needs phosphoric acid. On the other hand, if the plant grows slowly, has not a good color, and matures its fruit before it reaches a fair size, it indicates that the soil requires nitrogen.

It is now settled that as a rule most of the soils of the South are deficient in both nitrogen and phosphoric acid, and some in potash. So when we buy commercial fertilizers we buy them for their content of these substances. If the farmer has saved all his manures and has grown cowpeas abundantly, as he should, he will rarely have to buy nitrogen.

HOW TO BUY FERTILIZER.

Commercial plant food, called fertilizer, is never sold pure, but in combination with other substances. The substances with which it is combined are of no value to the farmer, but simply add to the weight. The laws of nearly all of the States now require that on each sack of commercial fertilizer shall be stamped just what plant food it contains. This composition is given in percentages, which means that in a hundred pounds of the fertilizer there are so many pounds of the particular substances. For example, a certain fertilizer is offered for sale on the sack of which is branded the following:

Nitrogen	3 per cent.
Soluble phosphoric acid	6 per cent.
Reverted phosphoric acid	4 per cent.
Available phosphoric acid	10 per cent.
Potash	2 per cent.

Translated into terms of pounds, this means that in a sack weighing 100 pounds there are—

- Three pounds of nitrogen.
- Six pounds of soluble phosphoric acid.
- Four pounds of reverted phosphoric acid.
- Ten pounds of available phosphoric acid.
- Two pounds of potash.

This gives a total of 15 pounds of plant food in a 100-pound sack. When a ton of such fertilizer is bought, the purchaser secures nitrogen, 60 pounds; soluble phosphoric acid, 120 pounds; reverted phosphoric acid, 80 pounds; and potash, 40 pounds. Notice that what is called “available” is the sum of the soluble and the reverted acid. In this fertilizer we obtain three things that are of use—3 pounds of nitrogen, 10 pounds of phosphoric acid, and 2 pounds of potash to the hundred pounds.

If cotton-seed meal, acid phosphate, and kainit are used to make this fertilizer, it will require the following quantities for one ton of the mixture :

	Pounds.	Price per ton.	Cost.
Cotton-seed meal -----	690	\$25.00	\$8.65
Acid phosphate (15 per cent available) -----	1,108	15.00	8.31
Kainit -----	202	12.00	1.21
	2,000	-----	18.17

In some cases, in a guaranteed analysis there is inserted a line giving the equivalent of the nitrogen in ammonia. Ammonia is nothing but nitrogen in combination with another substance of no value ; consequently, as in the former instance, there is nitrogen, phosphoric acid, and potash. Inserting the ammonia in the formula is apt to deceive one who does not know the distinction. What is necessary is to buy fertilizer in accordance with the analysis. Remember that it is the pounds of plant food that are wanted, and not just a sack of stuff the majority of which is of no value.

Since it costs just as much for freight and for handling this "filler," as it is called, as it does for the plant food, it is manifestly to the farmer's interest to buy that fertilizer which contains the greatest amount of plant food. Taking acid phosphates as an example, we find that there is a great variation in their composition. Some run as low as 10 pounds of available phosphoric acid to the hundred pounds, while others contain as much as 14 to 15 pounds. As phosphoric acid generally sells at about 5 cents per pound, the former would be worth 50 cents a hundred, whereas the latter would cost 75 cents. But it will cost as much for freight and for handling the former as the latter, while in the latter we actually get 50 per cent more plant food to the ton. In buying, then, it is economy to take high-grade goods although they cost a little more.

An average sample of cotton-seed meal contains—

Nitrogen -----	7.5 per cent.
Phosphoric acid -----	2.5 per cent.
Potash -----	1.5 per cent.

A 100-pound sack will therefore contain the following quantities of plant food :

Nitrogen -----	7.5 pounds.
Phosphoric acid -----	2.5 pounds.
Potash -----	1.5 pounds.

The phosphoric acid may be considered as available, as the fermentation renders it so.

HOW TO USE COMMERCIAL FERTILIZERS.

Since commercial fertilizers act in two ways (that is, perform the double functions of supplying food direct to plants and of rendering available plant food already contained in the soil), their most economical use is as supplements to the home supply of manure. It is not possible to permanently improve a soil by the use of commercial fertilizers alone.

In order to effect a permanent increase in the soil's production, commercial fertilizers should always be used in connection with stable manure, green manuring, and rotation of crops. By green manuring is meant turning into the soil at least once in every two years a crop of vegetable matter, preferably cowpeas or clover. We should also have our soil in the best mechanical condition and give the best of cultivation. The question of the right amount of moisture is a very important one, for the best results can not be obtained with either too much or too little. For plant production it is absolutely necessary to have a supply of decayed vegetation (humus) in the soil.

The final question is how and when to apply the fertilizer.

Where quantities of from 200 to 400 pounds are to be used, the fertilizer is best applied from a week to ten days before the time of planting. With these quantities apply as follows:

After the bed is thrown up, open the same with a furrow down the center, being careful to open it at least 1 to 2 inches deeper than it is intended to put the seed. Distribute the fertilizer either by hand or with a machine in this furrow, mixing it with the soil by running a bull-tongue at least twice in the drill; then close the drill with a harrow and reopen for the seed, or drop the seed with a planter, being careful that it does not come in direct contact with the fertilizer. This mixing of the fertilizer with the soil and preventing direct contact with seed is very important. If the seed and fertilizer are in contact the vitality of the seed will be wholly or partially destroyed and the result will be a poor stand. If the fertilizer is not mixed with the soil the crop is apt to fire badly with the first dry spell.

If larger quantities than those mentioned are to be used, then it is well to put one portion in the drill, and at the first working of the crop bar off a light furrow on both sides of each row and apply the balance, covering it by subsequent cultivation.

Soils and plant requirements vary so much that it is not possible in a general article of this kind to tell just what mixtures to use. As a rule our farmers will find cotton-seed meal and acid phosphate the best fertilizers, and unless large quantities are to be used they had better mix these themselves. Very poor soils will do well with a mixture of two parts by weight of cotton-seed meal and one part of acid phosphate for corn. The same soil would require equal parts of meal and acid phosphate for cotton. On better soils, especially soils that have grown cowpeas the year previous or to which stable manure has been recently applied, the latter mixture would do for corn, and then it would suit cotton were we to use two parts of acid phosphate to one of cotton-seed meal. On the richest soils very little nitrogen is required and three parts of phosphate to one of cotton-seed meal is about right.

An intelligent use of commercial fertilizers is important. When used in this way they are a valuable aid to the farmer and are a great factor in assisting him to fight the boll weevil, but it will not do to depend upon them alone. If this is done, he soon pays the penalty in a failure of the crop.

While soils deteriorate when we depend upon commercial fertilizers alone, this deterioration is not so much due to their impoverishment by the action of the fertilizer as to the destruction of vegetable matter. A soil devoid of vegetable matter is unproductive no matter how much plant food it may contain. Such soils are exceedingly subject to the effects of drought. Therefore, in order to derive the greatest benefits from the use of commercial fertilizers it is necessary to use barnyard manures and green-crop manures abundantly with thorough tillage.

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